VEGETABLE MORPHOLOGY A CENTURY AGO. — LINNÉ AND WOLFF.

"Um die geschichte der wissenschaften aufzuklären, um den gang derselben genau kennen zu lernen, pflegt man sich sorgfältig nach ihren ersten anfängen zu erkundigen."— GOETHE.

In order to clear up the history of the sciences, and to learn to know with exactness the progress of the same, we are wont to give careful attention to their earliest beginnings.

To students of natural science no term is more familiar than 'morphology,' and no doctrine more commonly accepted and understood. Pre-eminently reasonable and natural, the morphology of plants in particular appeals to the simplest understanding. Every schoolboy who has prepared his perfunctory herbarium, or accomplished his stint in plant-analysis, knows something of the meaning of a flower, can tell something of its natural history, — how that bract and sepal and petal, stamen and carpel, are but so many modifications of an ideal leaf, so many varied expressions of a single thought. Likewise the facts to be cited in proof of such assertions are familiar to every-day experience. Who has not gathered pond-lilies, and noted how, by the steps of imperceptible transition, Nature passes on from green sepal to perfected anther? 'Double' flowers of all sorts grow in country gardens, and in springtime the woodland offers anemones which are both 'double' and green. Even prolification is widely known in fact, if not in name.

To all these morphological facts, strange and curious as they certainly are, no one ever attempts to apply any other than the accepted explanation: no other is conceivable, none other is needed. And yet much of the ease with which such explanations are received must be considered due to the habits of thought now prevalent in the world, to the very atmosphere in which to-day men are called to think, to judge. In all the world of thought, ideas of transition are so rife, that unity or community of origin, even of objects most dissimilar, excites small surprise: it is the natural supposition. A different atmosphere, different habits of thought among men, would change completely the simplicity of many a modern page. It is, then, not surprising that a century ago morphology, as we know it, had not so much as found a name; that, with the same facts before them, the best minds in Europe were struggling to the perception of this simple theory, which the schoolboy may now appreciate and understand. The first perception of natural truth, like the opening-up of unknown lands, is a discovery, dim enough when seen in prospect, however easy when once accomplished. Linked with the botanical discovery here to be considered are three most brilliant names, two the brightest of their century, — Linné, Wolff, Goethe; not that all contributed equally to the establishment of the truth, but that to each the problem came, and for it each found answer. What answer to the floral problem each of these great men could give, it is our purpose here briefly to set forth, considering first the labors of Linné and Wolff, later those of Goethe.

Linné, the first in order of time, may be said to have discovered the problem. Passing his life in the study of flowers, the question 'What is a flower?' must have come to the great botanist again and again, pressing him by its very omnipresence almost to his annoyance. But to Linné, fortune-favored, the whole natural world lay like an undiscovered country, — a world too wide for the comprehension of any one mind, however active or versatile. It has been the marvel of all men since his time, that Linné did so much, that his instincts were so true, that to so many questions he gave answers which are the end of controversy. But as regards the morphological problem, the great naturalist seems never to have arrived at a definite conviction. Every thing he says on the subject is more or less obscure. Here, for once, he seems to have reasoned *a priori*, and fancy strangely supplements and distorts the facts discussed. The coincidence of number afforded by the successive layers in the make-up of the stem and the successive circles of organs in the composition of the flower struck him as affording a plausible explanation of the origin of the latter structure. Here are four layers, — the outer bark, the inner bark, the wood, and the pith. The outer bark is often on growing stems green, passing to all appearances imperceptibly into the green covering of the calyx; from the inner bark, white and delicate, come the delicate petals of the corolla; while from the cellular xylem and pith of the stem arise the circles of stamens and carpels respectively; and in the young flower-bud are not the organs last named simply masses of cellular tissue hardly to be distinguished from forming wood and pith? A more careful anatomy would have revealed the mistake; for, as Goethe points out in this connection, "it is the inner bark alone which possesses all power of life and growth;" the other parts of the stem having in the main taken on definite character, and been relegated to inactivity. If we may regard the 'pith' at the end of the growing axis as primary *meristem*, then so far so good; and the fancied relationship is not without its grain of truth.

But Linne did better than this toward the solution of our problem. In his 'Philosophia botanica' of 1751, he, among other things, makes the following propositions: —

"Principium florum et foliorum idem est,"
"Principium gemmarum et foliorum idem est,"

which, so far as it goes, would seem a clear statement of the truth; but it is doubtful whether the author, as he wrote, appreciated the full import of his words. Certainly his immediate followers and pupils did not. He stood face to face with the truth, but recognized it not, and turned away from it, and from the only line of thought which could possibly lead to light, only henceforth to wander in vain speculations and obscurities pertaining to his theory of prolepsis, — a theory understood neither by his contemporaries, his successors, nor possibly even by himself.

But while Linné was thus hopelessly lost in the mazes of his own imaginings, another mind, working in an entirely different field, took cognizance of the problem. A young student, afterwards known to fame as Caspar F. Wolff, away in central Germany in Frederick's university of Halle, had caught the spirit of genuine scientific research, and in his thesis for graduation in 1759 published an exact, succinct, and perfectly clear statement of the modern doctrine of vegetable morphology. Wolff had ideas of his own concerning generation in all the organic world, more particularly in the world of animal life. His taste lay in the line of anatomy in its ordinary scope; and the reference in his thesis to matters botanical was entirely apart from the chief purpose of his dissertation, simply incidental for the sake of completeness; and perhaps, with the propositions of Linné, above cited, before him, he had no thought of propounding any thing new to botanical science. In perfect harmony with his subject, Wolff undertook to elucidate the origin of the various organs of a plant, and in so doing was struck with the extraordinary similarity everywhere patent. Regarding the involucre of the 'compound' flower as calyx, he perceived easily the intergradation of foliage and sepals; the ripened capsule, with bursting sides, afforded evidence of the foliar nature of the carpels; that the seed is largely made up of leaves, appears when it germinates, and the cotyledons assume and perform, to some extent at least, the leaf's function; sepals and petals are often interconvertible, and stamens not infrequently show transition to petals: consequently in the entire plant, so far as immediate analysis goes, we find nothing but root, stem, and leaves.

As Wolff's thesis had to do with generation, and not at all with botany, it is a matter of no surprise that he regarded all this simply as introduction, and went on with his 'theoria generationis,' alleging that the formation of flower and fruit is due to failing energy in the plant; that all modifications have origin in the gradual withdrawal of vegetative power, which diminishes in amount as growth continues, and finally vanishes altogether. What Wolff hoped might be science, has been forgotten; what he lightly esteemed, is science, — fact not without significance, and certainly not without parallel in the history of intellectual work.

But if Wolff did not appreciate what he had accomplished, neither did any of his contemporaries. The seed fell not into good ground. The great Haller was yet living and working, at once botanist, anatomist, and poet; but he saw not the truth, although certainly familiar with Wolff's writings. The Jussieus were busy in Paris, arranging and re-arranging in the Jardin des plantes; but they heard nothing of Wolff: the time was not yet. The scientific vision of the age, dazzled by a sudden discovery of Nature's richness and variety, was not yet ready to be concentrated upon any single problem, however interesting that problem might be in statement, or far-reaching in outcome and solution. T. H. McBride.

VELOCITY AND SEDIMENT.

The observations on velocity and sediment on the Mississippi River, from Cairo to the head of the Passes (1,060 miles), have not confirmed the conclusion of Mr. Login, in 'The benefits of irrigation in India,' regarding the relation between these two functions of flowing water. His conclusion is thus stated: "The author believes that the power of water to hold matter in suspension is directly as the velocity, and inversely as the depth. It is also suggested that water in motion rolls rather than slides, and that it is owing to this rotary motion that water has the power to hold matter in suspension; further, that, with given velocities and defined depths, only a certain quantity of matter can be held in suspension, whatever may be the character of the bed or bank of the river or canal. If the velocity be increased, and the depth remain constant, scour will take place. If the velocity be decreased, and the depth is the same, there will be deposit."